(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

Rec'd PCT/PTO 27 JAN 2005

(43) International Publication Date
8 January 2004 (08.01.2004)

PCT

(10) International Publication Number
WO 2004/004172 A1

(51) International Patent Classification[7]: H04B 15/00, H04L 27/10, 27/22

(21) International Application Number: PCT/IB2003/002088

(22) International Filing Date: 29 May 2003 (29.05.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/393,083 1 July 2002 (01.07.2002) US

(71) Applicant *(for all designated States except BB)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).

(71) Applicant *(for BB only)*: **NOKIA INC.** [US/US]; 6000 Connection Drive, Irving, TX 75039 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BORRAN, Mohammad, Jaber** [IR/US]; 6100 Main Street, ECE Department MS-366, Rice University, Houston, Texas 77005 (US). **SABHARWAL, Ashutosh** [IN/US]; 6100 Main Street, ECE Department MS-366, Rice University, Houston, Texas 77005 (US). **AAZHANG, Behnaam** [US/US]; 6100 Main Street, ECE Department MS-366, Rice University, Houston, Texas 77005 (US).

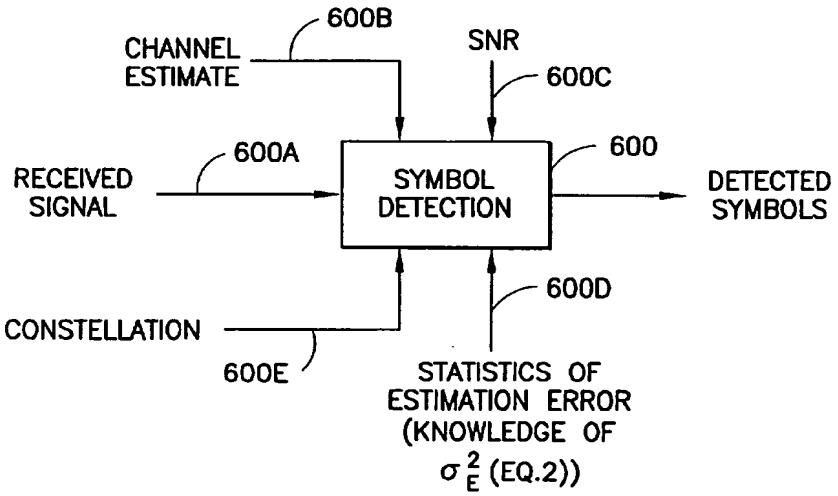
(74) Agent: **SMITH, Harry, F.**; Harrington & Smith, LLP, 4 Research Drive, Chelton, CT 06432 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,

[Continued on next page]

(54) Title: METHOD AND APPARATUS TO ESTABLISH CONSTELLATIONS FOR IMPERFECT CHANNEL STATE INFORMATION AT A RECEIVER



(57) Abstract: The system and method utilize design criteria and construction for signal constellations in communication systems, such as cellular telephony, that have imperfect channel state information at the receiver. The system and method assume an imperfect knowledge of fading channel state information (600B) and statistics of channel fading (600D) are used to encode additional information into the space-time matrix signal constellation as variations in amplitude of constellation (600E) points. In the preferred embodiment space-time matrix constellations and design criterion are based on the Kullback-Leibler distance between conditional distributions.

WO 2004/004172 A1

ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:
— *with international search report*